U. S. DEPARTMENT OF AGRICULTURE

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THE MELON APHID AND ITS CONTROL

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WHEN cucumbers, watermelons, muskmelons, and like crops are not growing properly, and especially if the leaves are curled or lady beetles or ants are noticed on the plants, they should be carefully examined for the presence of the melon aphid, which may be the cause of the poor growth.

The melon aphid, or "louse," is very small, varies in color from light green to dark green, and the wingless forms are louselike in appearance.

The melons and cucumbers become infested from winged forms of the aphid which develop on other food plants and fly to these crops, where they start new colonies, multiply rapidly, and become very destructive. The insect feeds on the underside of the leaves by sucking the plant juices, and causes the leaves to curl, wither, and die. As the vines on large areas may be killed in a short time, a constant lookout should be kept for the first signs of the insect and control measures promptly applied.

Although the melon aphid has more than 40 known natural insect enemies which assist in holding it in check, artificial control becomes necessary when conditions are favorable to its development.

This bulletin gives a general account of the insect and its manner of feeding and describes methods of control, the most effective of which is treatment with nicotine applied in a dust carrier, as described on pages 9 and 10.

This bulletin is a revision of and supersedes Farmers' Bulletin 914, entitled "Control of the Melon Aphis."

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THE MELON APHID[1] AND ITS CONTROL

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CONTENTS

	Page		Page
Description of insect and nature of attack	1	Seasonal history	4
Distribution	3	Insect enemies	4
Food plants	4	Methods of control	5

DESCRIPTION OF THE INSECT AND NATURE OF ATTACK

THE MELON APHID[1] (fig. 1), more commonly known as the melon louse, injures plants by piercing them with its beak and sucking the plant juices. It is a minute, soft-bodied creature of sluggish habit and variable color, usually of some shade of green or greenish black, and in its young and wingless stages is louselike

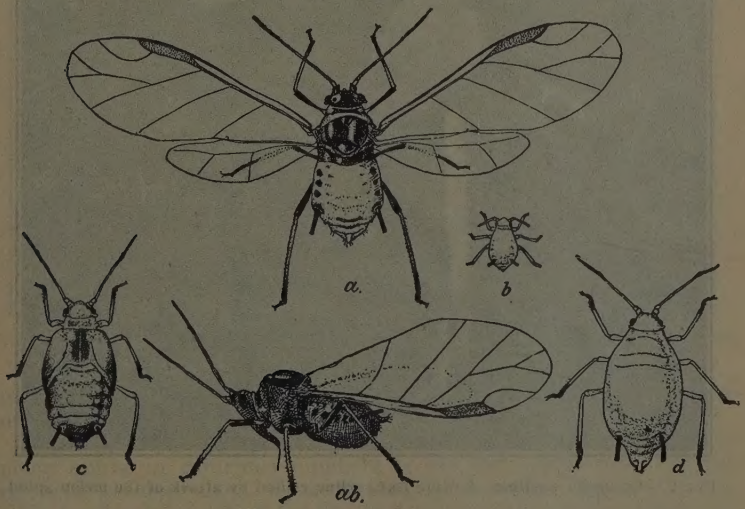

FIG. 1.—The melon aphid: *a*, Winged female; *ab*, dark female, side view; *b*, young nymph; *c*, last stage of nymph; *d*, wingless female. All greatly enlarged. (Chittenden)

in appearance. The wingless female (fig. 1, *d*) is from one-sixteenth to one-fourteenth of an inch long. The body of the winged female aphid (fig. 1, *a*, *ab*) is more slender than that of the wingless form, and is from one-twentieth to one-fourteenth of an inch in length.

[1] *Aphis gossypii* Glover; suborder Homoptera, family Aphididae.

It may occur from early spring to late fall on muskmelons, watermelons, and other cucurbits, and on various other plants, as it is rather a general feeder. Infestation of cucumber and melon crops takes place through winged females which fly from other food plants to the melon field, where, by producing young, new colonies are started. The individuals of these colonies soon develop into

FIG. 2.—Cucumber seedling, showing leaf curling caused by attack of the melon aphid

mature forms which are capable of reproducing very rapidly. In seasons which favor its increase, especially during warm, dry periods, the insect frequently develops in enormous numbers and does very serious damage. The attack is first confined to the undersurface of the leaves of the plant, where the insect feeds in masses, causing the leaves to curl (fig. 2), lose color, shrivel, and finally die. As the pest multiplies it spreads to the tender terminal shoots, where the harmful effect of its feeding is shown by the stunted and

distorted growth of this section of the vine (fig. 3). Such injury results in a decreased yield and in poorly developed, prematurely ripened fruit.

The melon aphid is by far the most abundant and destructive aphid, affecting cucumbers, melons, and other cucurbits, and is not likely to be confused with any other aphid occurring habitually on the same class of plants.[2]

The presence of lady beetles and ants about the melon plants is usually an indication that the melon aphid is present also. The lady beetles feed on the aphids, and the ants upon the honeydew excreted by them. When the aphids are unusually abundant the leaves and young fruit of the infested plants become covered with a thin, sticky coating of this excretion, to which the white molted skins of the aphids adhere. When this condition exists the injury

FIG. 3.—Injury to terminal shoots of melon plant caused by the feeding of the melon aphid

has developed to such an extent that the plants rarely recover and make normal growth, even if the insects are controlled.

Too frequently it happens that by the time the presence of the melon aphid in injurious numbers is noticed, irreparable damage has been accomplished. It is necessary, therefore, that the melon fields be closely watched for the first appearance of the insect and that remedial measures be undertaken immediately.

DISTRIBUTION

The melon aphid is known to occur in the West Indies, Mexico, Brazil, Hawaiian Islands, South Australia, South Africa, and the East Indies.

[2] The potato aphid (*Macrosiphum solanifolii* Ashm.), a much larger species, attacks cucurbits but seldom causes noticeable damage.

It is somewhat generally distributed throughout the United States and frequently is reported as doing more injury in the South and Southwest than elsewhere, and it is a serious pest in the Gulf region. At any time, however, it may create more or less trouble in more northern and eastern regions, particularly in Maryland, Virginia, Delaware, and New Jersey. It is also especially troublesome in the melon-growing districts of California and Florida. Occasionally it is injurious as far north as Maine and Minnesota.

FOOD PLANTS

The melon aphid is partial to the muskmelon and other melons, cucumber, pumpkin, squash, wild gourd and other cucurbits, cotton and okra, on all of which it feeds and multiplies freely.

The following list includes the cultivated plants on which the insect has been known to feed, though to a less extent than on melons and other cucurbits: Cotton, hops, strawberry, beans, sugar and table beets, spinach, tomatoes, clover, and asparagus; citrus trees; catalpa; and ornamental plants such as violet, hydrangea, begonia, ground ivy, acalypha, and morning-glory. It also feeds on common weeds such as shepherd's purse, peppergrass, great ragweed, dock, fleabane, milkweed, burdock, dandelion, lamb's-quarters, plantain, chickweed, and mallow. In the absence of their favorite food plants, the winged forms may start colonies on any of these.

SEASONAL HISTORY

The attack of the melon aphid on cucumber or melon plants begins in early spring or later, depending upon locality and climate, and may continue throughout the entire growing season. Infestation naturally begins earlier in the South than northward and may occur simultaneously with the appearance of the crop above ground. As a rule, however, soon after the plants have developed leaves, a few winged aphids appear, forerunners of the myriads which develop from them.

In areas in which climatic conditions permit, the insect continues to multiply throughout the greater part of the year. In northern latitudes it appears in the spring in small numbers and multiplies rapidly as soon as the weather becomes warmer.

INSECT ENEMIES

The melon aphid has many natural enemies which play an important part in keeping this pest in check. About 40 species of insects are known to prey upon it. The list includes many lady beetles (also called "ladybugs" and ladybirds), which destroy both young and adult aphids; the maggots of certain syrphus flies, which consume large numbers of the "lice"; and aphid lions, which are the young of lace-wing flies. A number of species of minute parasitic, four-winged, wasplike insects are very important checks on the increase of this aphid. Parasitic fungi also destroy many.

Of the natural enemies which have been enumerated, lady beetles are particularly efficient as aphid destroyers, principally because they are active throughout the growing season but especially at the outset of the aphid attack. The adult lady beetles, practically always present on infested vines, usually survive treatment for the melon

aphid and continue action after plants have been treated with contact poisons.

Parasites are most effective in warm weather and multiply rapidly toward the end of the season.

METHODS OF CONTROL

To control the melon aphid it is necessary to employ a contact insecticide, that is, a substance which kills when it touches the body of the insect. The effectiveness of a contact insecticide depends upon the thoroughness of its application. Nicotine applied in the form of a spray or a dust is an effective control. During the application of the remedy the underside of the leaves should be examined from time to time to ascertain whether the spray or dust is reaching the insect.

NICOTINE DUST

Nicotine dust, a mixture of nicotine sulphate or nicotine (solution) with hydrated lime, has been found a very satisfactory remedy for the control of the melon aphid. The underside of the leaves, where the insects feed, can be more readily reached with a dust than with a spray. The fine particles of dust carrying the killing agent, nicotine, drift through and among the plant foliage and come to rest on the underside of the leaves; and also, if the dust is carefully applied to the leaves of the terminal shoots which have begun to curl, sufficient quantities to kill many of the "lice" will enter the curled leaves.

PREPARATION OF NICOTINE DUST

The preparation of nicotine dust consists in mixing nicotine sulphate or a free nicotine solution with hydrated lime or other carrier in such a manner that the liquid is evenly distributed throughout the mixture. When the dust is properly mixed each particle of the carrier has a small quantity of nicotine and the mixing of the nicotine solution with the lime or other carrier is manifested in the mixture only by a slight discoloration and the penetrative odor of the nicotine which is being given off as a result of mixing the two substances. A good grade of hydrated lime has been found a very satisfactory carrier and is usually readily obtainable at a small cost. Commercial nicotine sulphate and nicotine solutions which are generally used for insecticide sprays contain 40 per cent nicotine, although nicotine solutions with a higher nicotine content are on the market; but the latter are usually employed for fumigation purposes. The use of a nicotine solution containing 40 per cent nicotine, in the form of nicotine sulphate or as free nicotine, is recommended in the preparation of nicotine dust, as nicotine is more readily obtainable in this form. To prepare a 2 per cent dust the formula is:

Hydrated lime	95 pounds.
Nicotine sulphate or nicotine solution (40 per cent nicotine)	5 pounds.

or

Hydrated lime	19 pounds.
Nicotine sulphate or nicotine solution (40 per cent nicotine)	1 pound.

or

Hydrated lime	1 pound.
Nicotine sulphate or nicotine solution (40 per cent nicotine)	1 ounce.

In the preparation of the dust it is most important that the nicotine sulphate solution be thoroughly mixed with the carrier (hydrated lime, etc.). This can be accomplished by a sifting or mixing process, or by the use of a ball mill, which is a rotating drum containing many small balls to grind and mix the dust as the drum is slowly revolved. A homemade ball mill can be constructed from a 50-gallon vinegar barrel and stones or pebbles substituted for balls (fig. 4). A section about 6 by 14 inches is cut in the side of the barrel, and the pieces taken out are fastened together with pieces of half-inch strap iron on the inner side to constitute the door. The door is hinged and equipped with a fastener, or it may be fitted as shown in Figure 5. The edges of the opening or of the lid are padded with any convenient material in order to prevent leakage. A piece of pipe 1 inch in diameter and 10 inches long is attached to

FIG. 4.—Ball mill for mixing nicotine dust

the exact center of each end of the barrel by means of a flanged bushing, to form the axle upon which the barrel revolves (fig. 6). A crank made from material 2 by 4 by 15 inches is attached to one end of the axle, and a short piece of half-inch pipe set at right angles to the arm serves as a handle. The barrel is mounted on a stand which may conveniently be made from two trestles, about 36 inches high, with a notch in which the axle rests cut in the top of each trestle. To hold the barrel steady, with the opening conveniently placed for putting into it the stones and the material to be mixed, a bolt is passed through a hole in the trestle and into a suitable opening in the support for the flange on the end of the barrel, as shown in the figure. The barrel can be mounted on other types of stands, but should in any case be high enough from the floor to permit ease of operation and the ready placement and removal of a container to catch the dust when the ball mill is emptied. This container should

be at least 3 feet long, 2 feet wide and 1 foot deep. A coarse screen should be placed over the container to separate the stones from the dust.

Use one-half pound of stones or pebbles to each pound of dust.

To make 50 pounds of dust containing 2 per cent nicotine in the ball mill, first place the required stones in the mill, and on them 47½ pounds of hydrated lime. Then add 2½ pounds of nicotine sulphate solution (containing 40 per cent nicotine) by pouring it over the lime as evenly as possible. The nicotine sulphate can be weighed out in a fruit jar on an ordinary spring balance.

After the nicotine is added, close the lid of the mill tightly and turn the barrel for five minutes at the rate of about 35 turns a minute.

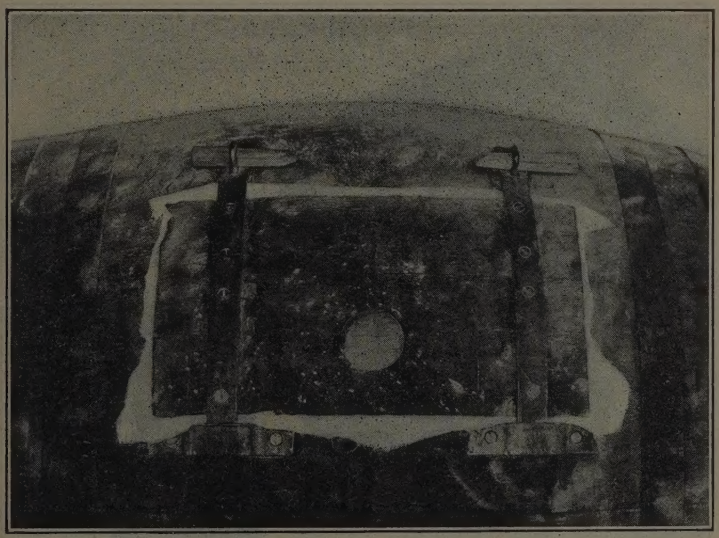

FIG. 5.—Ball mill. Details of door. One end of each iron strap is fastened under a clip at the edge of the opening; the other end, in which a slot has been cut, is secured by a staple and wooden wedge

The rate of turning should not be greater than this and the time in turning should not be less than five minutes in order to assure a proper mixing of the dust. When the dust is taken from the mill it should be poured through the coarse screen into a box or other container to separate the stones. If any dust sticks to the sides of the barrel, it can be removed by tapping the barrel on the outside. If the dust is not to be used shortly after it is prepared, it should be stored in air-tight containers, such as metal drums or lard tins. Dust which is being prepared for immediate use can be placed in the paper lime sacks and hauled to the field.

A satisfactory device for mixing the dust in 10-pound lots or less consists of a box, with a detached cover, in which a sieve is placed, and an ordinary floor brush with a handle attached is used to pass the dust through the sieve. A slot is cut in the end of the

box to allow for the operation of the brush when the cover is on. The cover serves to prevent the escape of the dust and to protect the operator from inhaling it during the mixing process (fig. 7).

A box 15 inches long, 10 inches wide, and 12 inches deep is of convenient size and shape. The sieve is constructed of window screening tacked to a frame which can be placed inside the box. The frame should fit snugly and rest on a strip around the sides of the box and about 6 inches from the top. The brush is an ordinary floor brush with edges trimmed off in such a way that the corners and edges of the sieve may be reached. The handle, 20 inches in length, is attached at right angles to the brush, and is so constructed that the brush will rest in a level position over the entire length of the

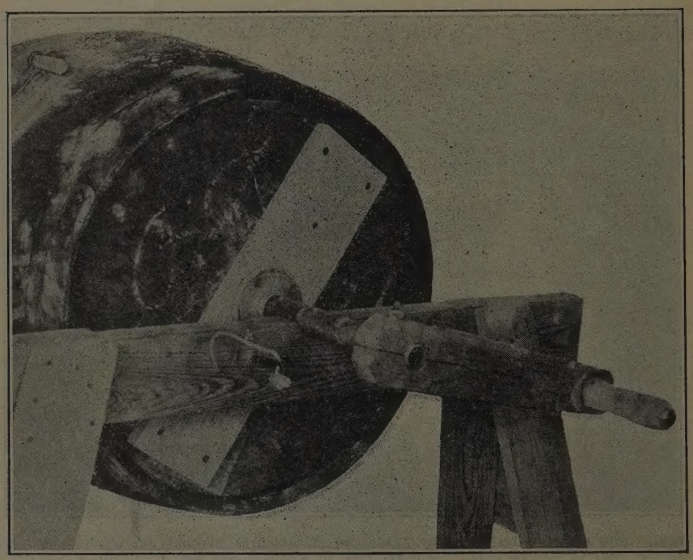

FIG. 6.—Ball mill. End view, showing attachment of axle and handle

sieve, and the end of the handle will project horizontally through the slot in the upper edge of the end of the box.

To prepare the dust with this apparatus, slowly add the required quantity of nicotine solution to the hydrated lime, thoroughly stirring the whole mixture. It should then be run twice through the sieve, with the aid of the brush. In the sifting process it should be made certain that all the soft lumps pass through the screen. These are formed when the nicotine solution comes in contact with the lime, and unless they are broken up so as to pass through the sieve much of the nicotine will be lost.

One to two pounds of nicotine dust, sufficient for the treatment of a small area or a few plants, can be prepared with an ordinary flour sifter similar to the type shown in Figure 8. The rotating piece of metal which passes over the screen as the handle is turned

serves the same purpose as the brush described in the box-and-brush method.

The dust produced after the nicotine sulphate is mixed with the hydrated lime should be passed through the sieve three times, and after the first sifting care should be taken to see that all the lumps which remain are broken up and passed through the sifter.

The various types of machines for mixing different materials can be purchased on the market, but are fairly expensive. The average grower would probably not be justified in purchasing so elaborate a machine solely for his own needs, but the installation of such machines by growers' associations or by individual growers who are in a position to manufacture the dust for other growers in the community might prove to be a good investment.

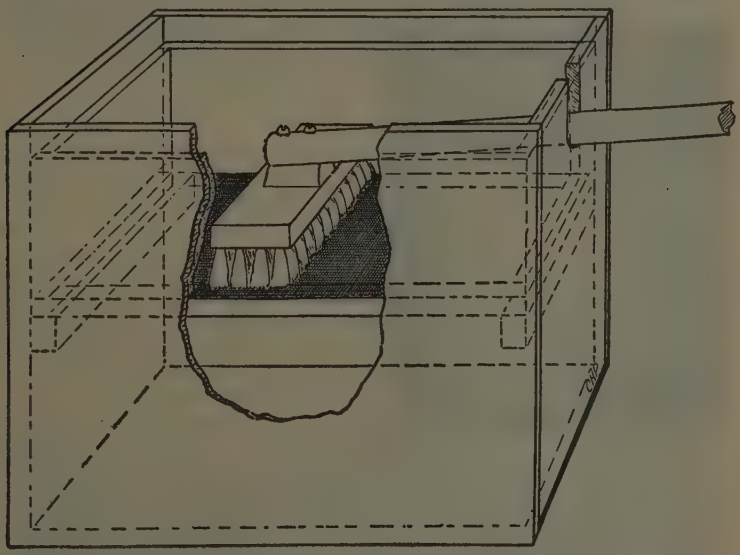

FIG. 7.—A mixer for use in preparing small quantities of nicotine dust. (White)

Nicotine dust in various strengths is prepared and offered for sale by a number of dealers in insecticides and can be purchased in quantity or in small lots. Nicotine sulphate solution (containing 40 per cent nicotine) can usually be purchased from seedsmen or dealers in agricultural supplies, and in small quantities from many drug stores.

APPLICATION OF NICOTINE DUST

A dust containing 2 per cent of nicotine, applied at a temperature above 70° F., and at a time when the foliage of the plant is dry, will effectively control the melon aphis. If practicable the dusting should be done when there is little air movement, so that the dust will settle on the plant and not be carried away by the wind.

When the dust is applied with a power or traction duster, full-grown plants will require from 35 to 40 pounds of dust per acre.

The treatment of small areas or a few plants with hand dusters will require about 1 pound of dust to a 25-foot row of nearly grown plants, younger plants requiring smaller quantities of dust.

The object in applying the dust should be to reach the underside of the leaves of the plant. The nozzles of traction or power dusters equipped with fixed booms should be spread apart and extend over the width of the row. They should also reach close to the top of the row and be directed slightly forward and downward toward its center. This arrangement will effectively carry the dust to the underside of the leaves.

In hand-dusting operations, as the duster is operated, the nozzle should be moved about among the leaves of the plant. A duster with a flexible discharge tube can be used to advantage in this work. If the discharge tube is equipped with a nozzle which will direct the dust upward, more satisfactory results will be obtained than with the use of a straight nozzle.

FIG. 8.—Flour sifter, used in preparing small quantities of nicotine dust

DUSTERS

For treatment of small areas and young plants, a hand duster (figs. 9 and 10) of 10 or 15 pounds capacity is satisfactory. By using a duster of this type small areas in a field may be treated conveniently whenever necessary. By local treatment one may kill the aphids in the early stages of infestation and prevent their spread over the entire field.

Where large acreages of well-developed plants are infested, power or traction dusters equipped with nozzles for dusting 2 or 4 rows should be used (figs. 11 and 12). When these machines are employed, better results are obtained if the dust is inclosed for a short time after leaving the nozzles. This can be accomplished by the use of a "trailer," one type of which consists of a piece of unbleached muslin attached to the frame of the duster above the nozzles and weighted down on the ends. The muslin should extend backward at least 20 feet from the machine and be of sufficient width to cover the nozzles and hang down to the ground at the sides of the machine, thus forming a sort of hood which will hold the dust around the plants for a short time as the duster passes over them. This "trailer" is especially useful if dusting operations are carried on when the wind is blowing.

In fields where the vines have extended across the rows it will be necessary to lay the vines back from the middle of the rows to allow for the passage of the duster. When a "trailer" is employed it is a good plan to have a person at the end of the rows to lift and turn it. The operator of the duster should also watch the trailer from time to time to see that the weights at the ends do

not become entangled in the vines, thus unnecessarily destroying them, or reducing the efficiency of the trailer.

A power duster mounted on a sled can be used in melon fields where the vines are cultivated in hills (fig. 13).

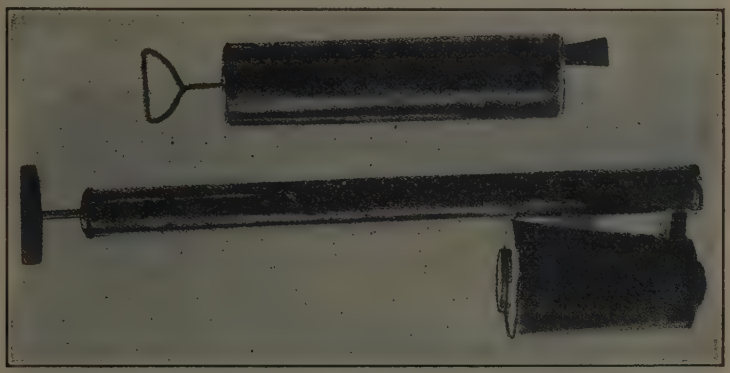

FIG. 9.—Two types of small hand dusters, suitable for small gardens. (Campbell)

NICOTINE SULPHATE SPRAY

As a spray for the melon aphid, a solution of nicotine sulphate (containing 40 per cent of nicotine) and soap gives satisfactory

FIG. 10.—Hand-operated bellows duster for applying nicotine dust to small areas, for control of the melon aphid. (Campbell)

results. The soap acts as a spreader, producing an even distribution of the spray over the leaf surface. Ordinary laundry soap will answer this purpose.

Several soaps, such as whale and fish-oil soaps, are manufactured for insecticidal purposes; they are soft and more easily dissolved

FIG. 11.—Four-row traction duster equipped with "trailer"

than laundry soap, and for large quantities of spray will be found more satisfactory.

FIG. 12.—Four-row traction duster with trailer folded back, showing discharge tubes and nozzles. These tubes are adjustable and can be set to cover rows of different widths

The spray should be mixed as follows:

Nicotine sulphate solution (40 per cent nicotine)	⅜ pint, or 6 fluid ounces.
Soap	4 pounds.
Water	50 gallons.

For small quantities of spray use:

Nicotine sulphate solution (40 per cent nicotine)	1 teaspoonful.
Soap	1 inch cube.
Water	1 gallon.

The required amount of soap should be dissolved in a small quantity of hot water and then diluted before the nicotine sulphate is added. Some time is required for fully dissolving the soap; to avoid delay this should, therefore, be done sufficiently in advance of the spraying operations.

SPRAYING MACHINERY

For effective application of a spray to control the melon aphid, it is essential that the sprayer be equipped with leads of a discharge hose and spray rods (fig. 14) to permit hand operation. This will

FIG. 13.—Power duster used with success in a badly infested melon field in California. (Campbell)

enable the operator to move the nozzle readily about the plants and direct the spray on the undersurface of the leaves. A sprayer with fixed boom and nozzles is of little value unless the nozzles are arranged to discharge the spray upward and sidewise from each side of a row, and the spray should be delivered at high pressure in order to move the leaves about so that the spray will cover the undersurface of the leaves.

Various types of sprayers may be employed, but a "hand" compressed-air sprayer is one of the most useful for treating small areas. It should be equipped with a flexible hose attached to a spray rod having an angle nozzle which will produce a mistlike spray. The spray rod should be of such length that the operator can readily reach the plants when he is standing in an upright position (fig. 15).

The wheelbarrow type of sprayer (fig. 16), or a barrel sprayer mounted on a cart, can be used to advantage for spraying fields of from 1 to 3 acres.

CULTURAL AND OTHER METHODS

Cultural methods are of considerable value in control. Clean farming or gardening with fall plowing should be practiced wherever possible; it is a valuable precaution for the prevention of injury by the insects that are nearly always present in the fields. The weeds in the vicinity of growing crops should be kept down as far as possible throughout the year, especially in late fall and early spring. They are available as food plants and may harbor the melon aphid.

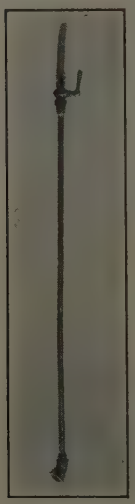

FIG. 14.—Spray rod equipped with angle nozzle, showing cut-off valve between hose and spray rod

VALUE OF FREQUENT INSPECTIONS AND EARLY WORK

Injury to the melon crop by the melon aphid can be reduced and in many cases actually prevented by the employment of control measures upon the first appearance of the insect.

FIG. 15.—Method of underspraying cucumbers with compressed-air sprayer. (Chittenden)

Since the aphids attack the underside of the leaves they must be combated before the leaves have become curled and wilted if serious injury is to be averted (see figs. 2 and 3). Injury from early infestation is usually noticeable by the time the runners are a foot long, but varies with climatic conditions and locality.

The field should be inspected at least once a week, not alone in one part, but in several, as the aphids are sometimes abundant in some sections of a field, scarce in others, and perhaps entirely absent from others. From the infested areas the whole field is likely to be overspread.

While the young crop is being cultivated, little difficulty will be experienced in detecting the presence of the aphid if a close watch is maintained for plants with curled leaves, or those upon which ants or lady beetles occur. As previously stated, the lady beetles feed on the aphids, and the ants attend them to obtain the honeydew they excrete. If the vines are turned during cultivation they may be readily examined. An unthrifty, wilted appearance of young plants may be caused by the feeding of this insect.

After the plants have reached the point in growth where no more cultivating is to be done, it is a good plan to go over the fields carefully about once a week, inspecting closely all plants which do not have a normal, healthy appearance. The plants found infested should be plainly marked so that they can be readily located for treatment. A short stick with a piece of cloth attached makes an excellent marker. During cultivation these sticks may be carried on the cultivator, where they will be readily available when needed.

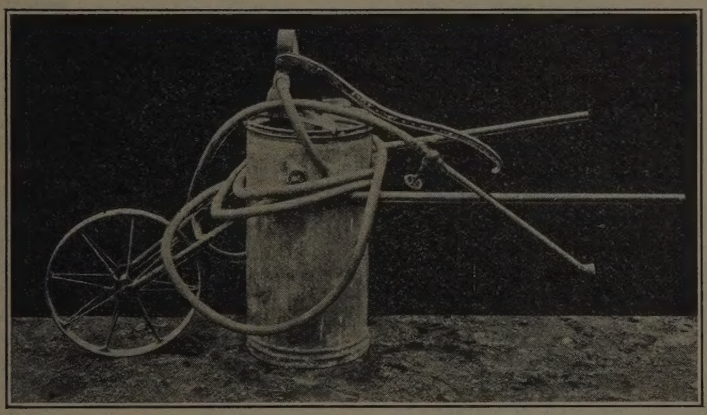

FIG. 16.—Wheelbarrow type of sprayer

The importance of detecting the insect while it is confined to small areas can not be overestimated, since prompt discovery is one of the most important factors in combating this pest.

In applying the remedy to a small infested area of mature vines, it is good practice to treat the plants adjacent to the infested ones so as to insure killing any aphids that may have spread from the original colony.

When a plant becomes so badly infested that it will not produce a crop, about the only measure that can be profitably undertaken is simply to pull out and bury the severely curled plants with the aphids on them. The less heavily infested surrounding plants should then be treated with either a spray or a dust.

SUMMARY OF CONTROL MEASURES

1. Inspect the melon or cucumber field at regular intervals, examining several sections of the field in order that small infesta-

tions may be discovered and the remedy applied before the field has become generally infested.

2. When the aphid is found, do not wait to find out whether it is going to increase, but dust or spray the infested areas as soon as possible.

3. Use the remedy best suited to your conditions and apply it properly and thoroughly, making frequent inspections to ascertain whether the underside of the leaves is being reached.

4. Treatment with nicotine dust should be made, where possible, when there is little air movement, when the temperature is about 70° F., and when the plant foliage is dry.

5. Be certain that the dust used contains the proper proportion of nicotine.

If persistent effort is made and the work is undertaken promptly, there should be little difficulty in protecting melons, cucumbers, and related crops from injury by the melon aphid.

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May 29, 1926

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